Much ado about relatively little: the resilience of trout populations to fire

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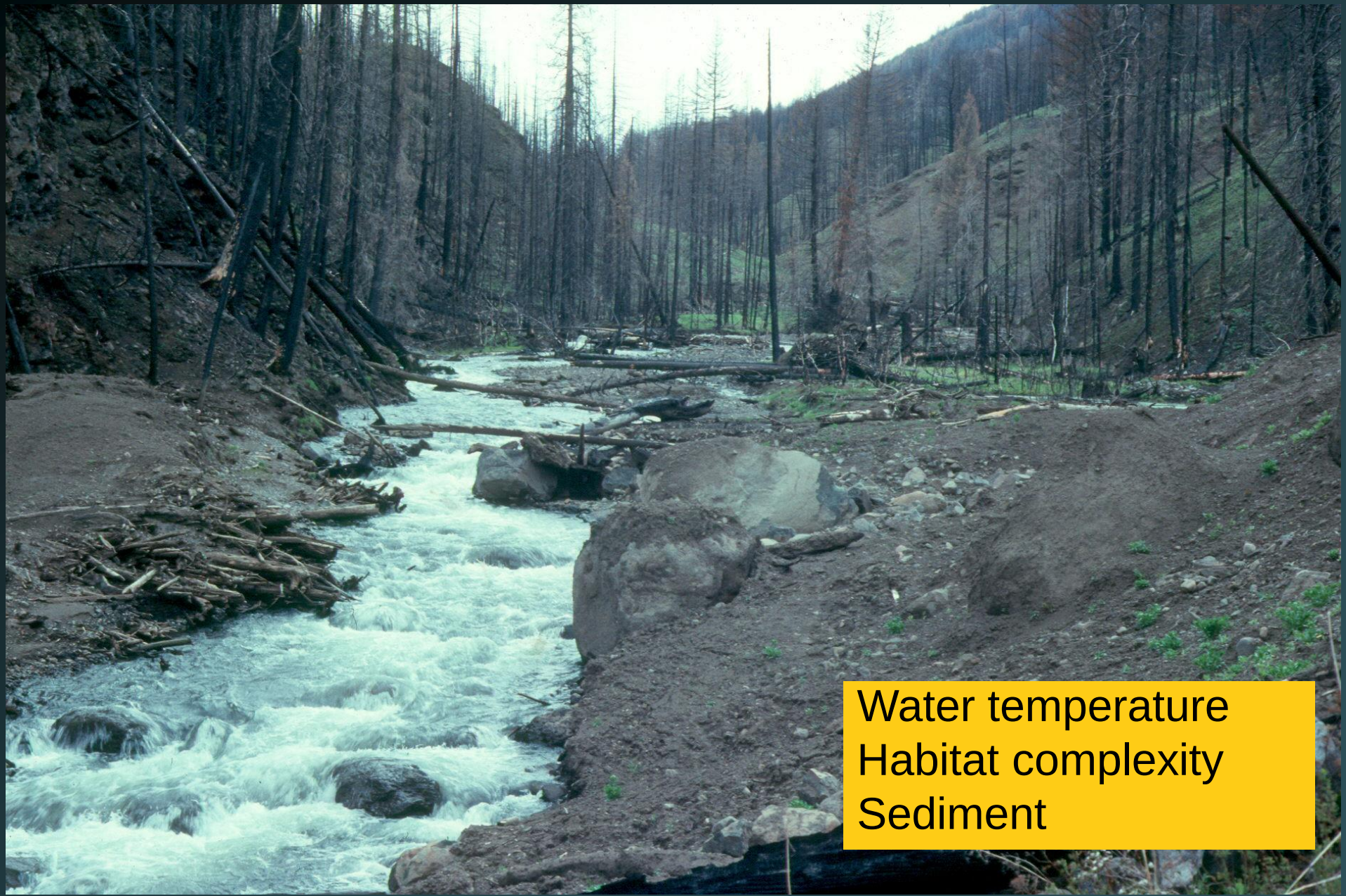
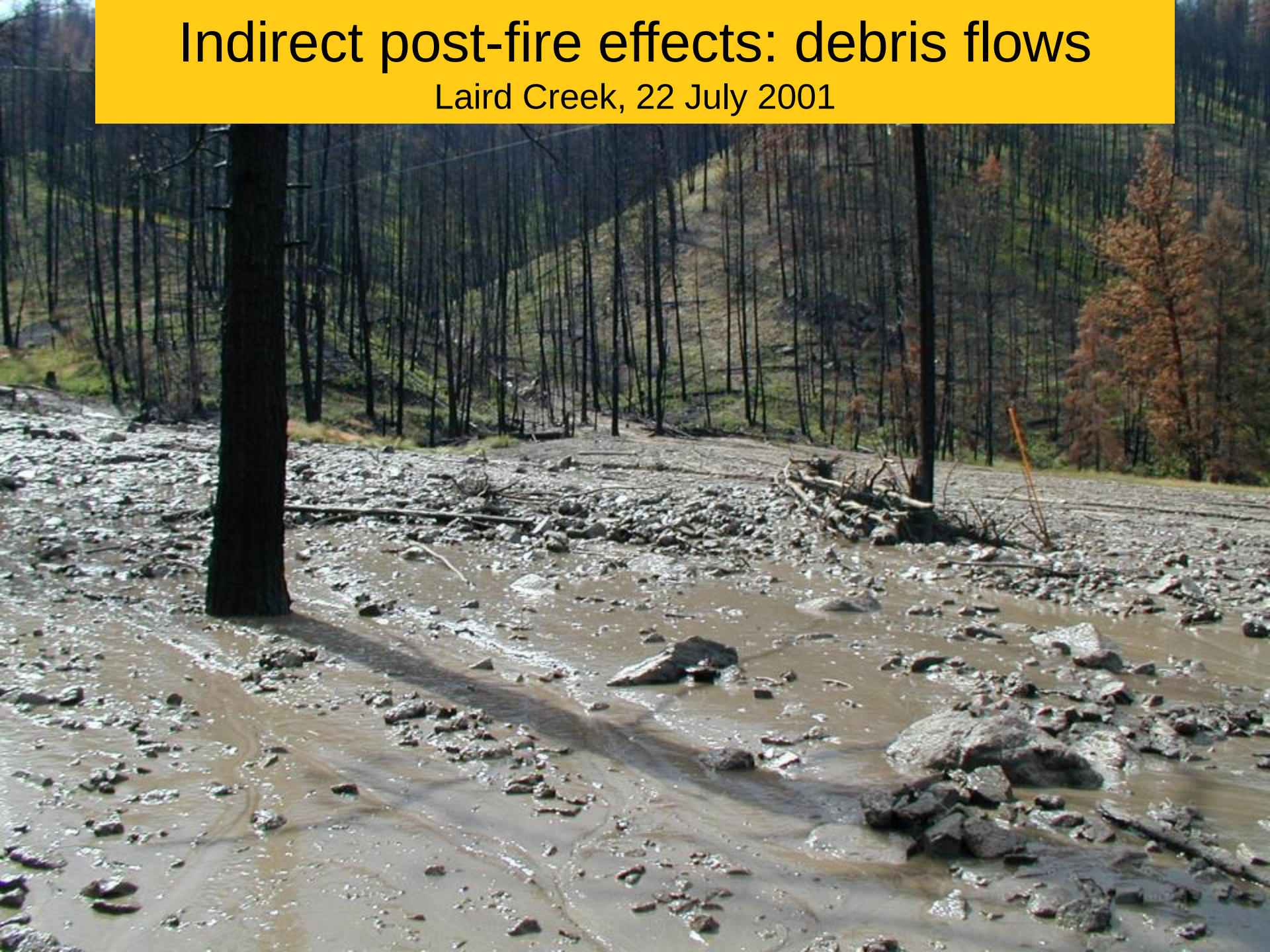
Direct fire effects

Indirect post-fire effects

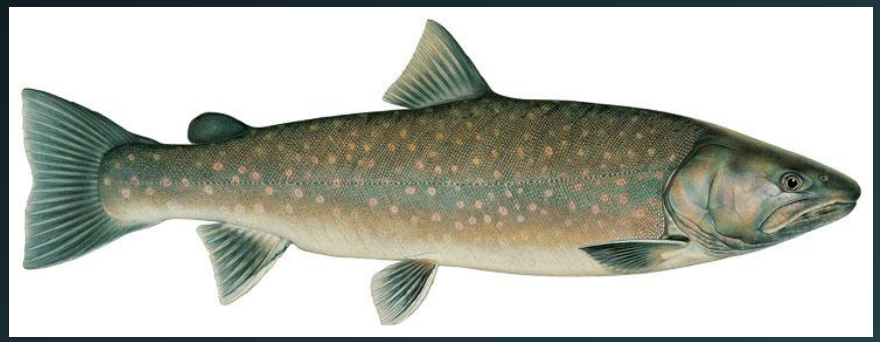


Indirect post-fire effects: debris flows

Laird Creek, 22 July 2001



Context: nonnative fishes



Hypotheses

↑ Disturbance severity

↑ Water temperature

↑ Sediment

↓ Habitat complexity

↑ Nonnative fish

↓ Native fish

↓ Biotic resistance

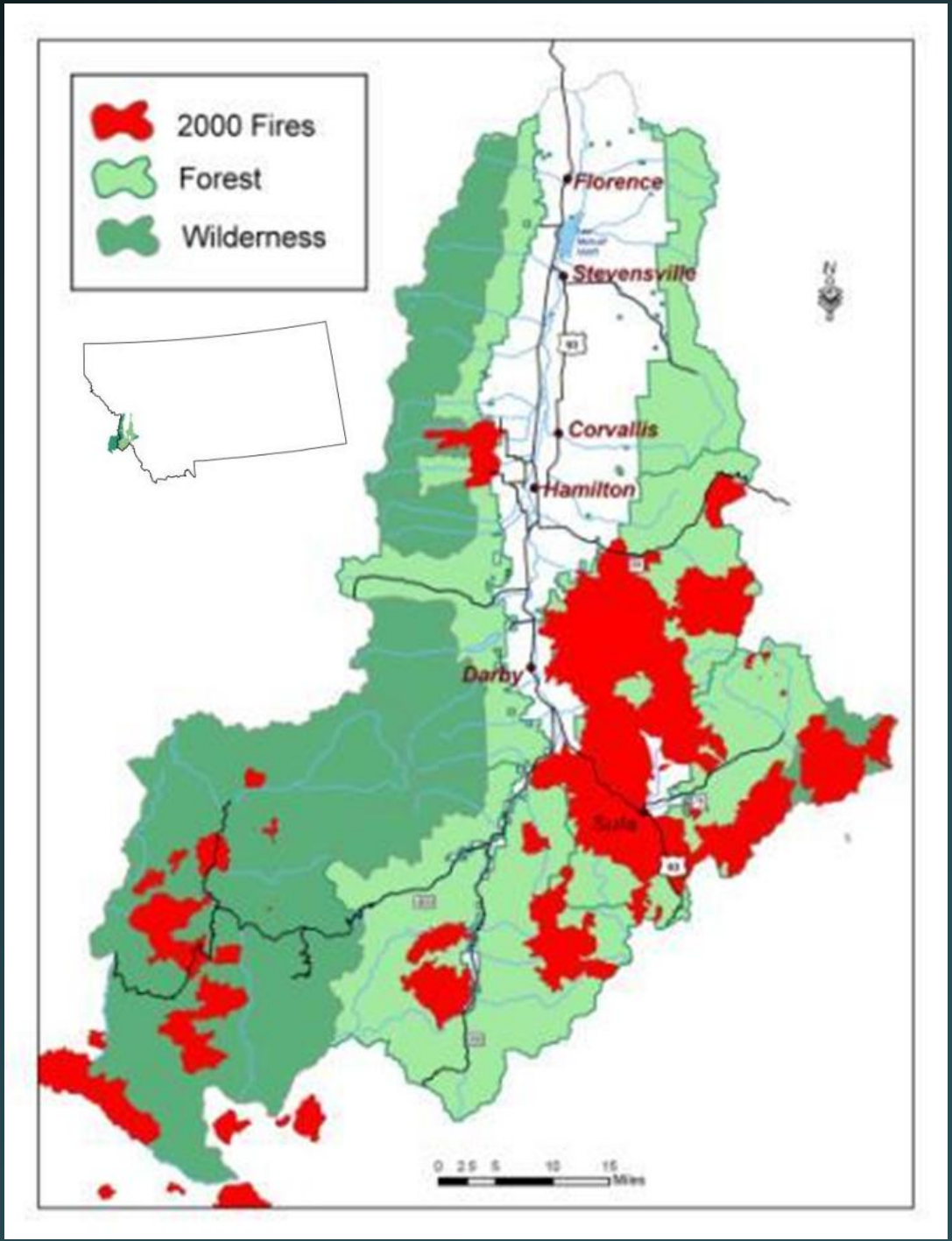
Nonnative fish invasion and replacement

2000 Bitterroot Fires

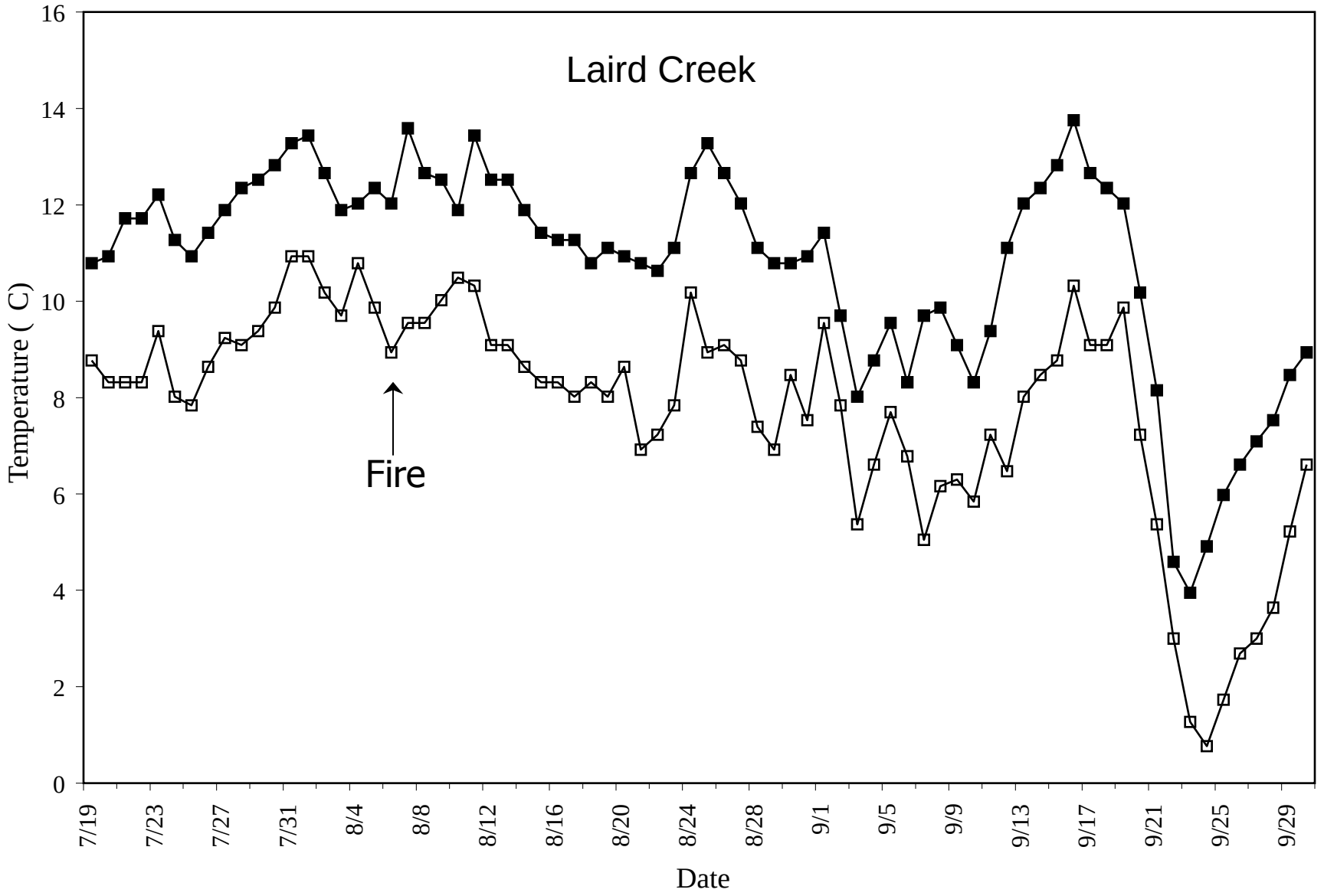
Extensive pre- and post-fire fish sampling (1985 to date)

Contemporary temperature measurements

Short-term post-fire habitat measurements (2001-2003)



Direct effects: thermal spike?



Indirect effects: short-term warming

Table 2. Differences in mean maximum water temperatures (°C) before (1999) and after (September 2000, July–August 2001) the 2000 fires

Period	Sites		
	Reference	Below burn	Within burn
September 1999–September 2000	2.1[a] (0.1)	2.3[a] (0.2)	3.5[b] (0.2)
July 1999–July 2001	−0.1[a] (0.1)	1.0[ab] (0.7)	1.9[b] (0.6)
August 1999–August 2001	1.8[a] (0.1)	2.1[a] (0.5)	3.7[b] (0.4)
September 1999–September 2001	3.2[a] (0.1)	3.0[a] (0.2)	5.4[b] (0.6)

Sites below burns lacked significant evidence of fire-related warming

Mahlum et al. 2011

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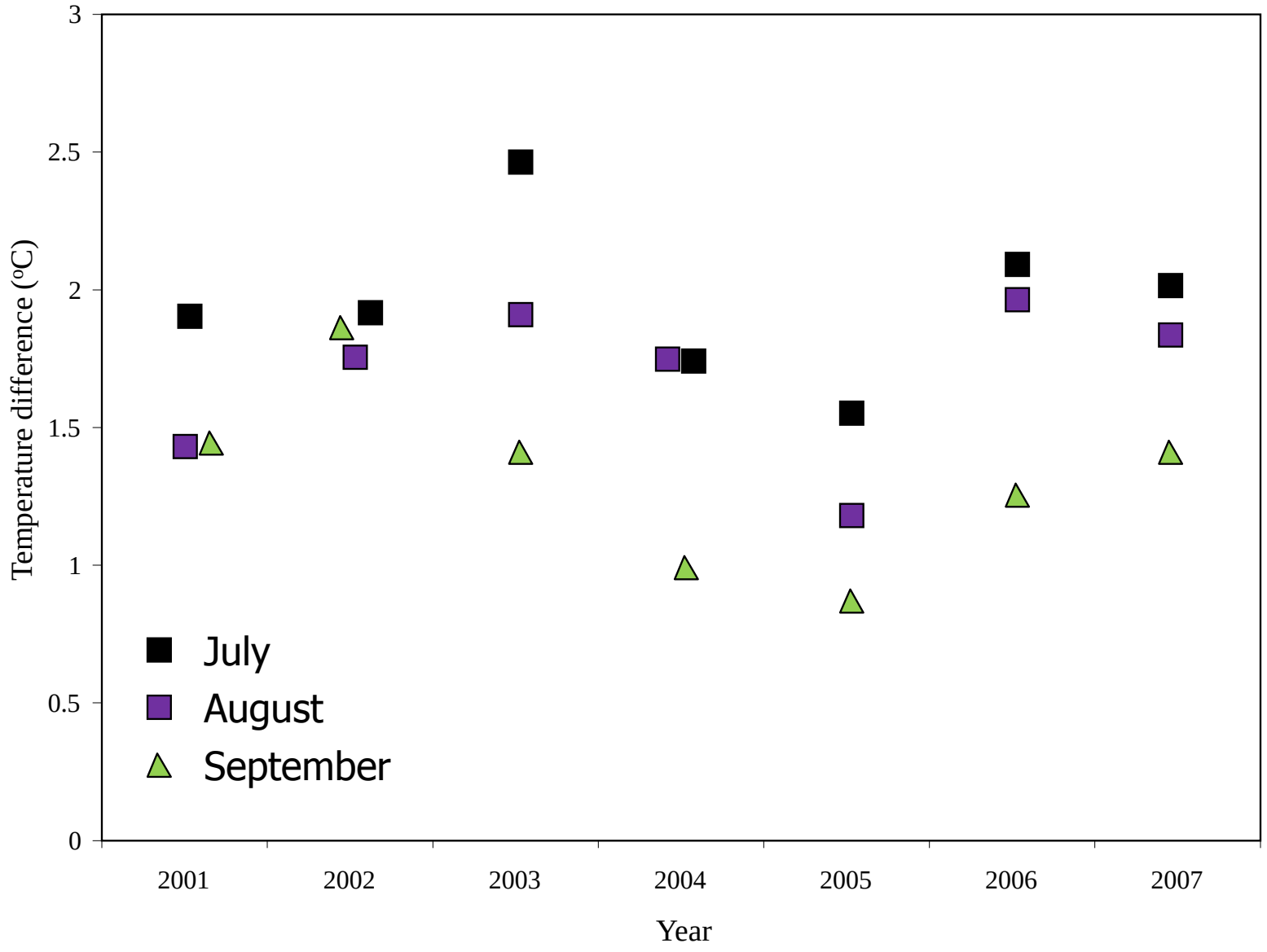
Sites within burns were warmer post-fire

Mahlum et al. 2011

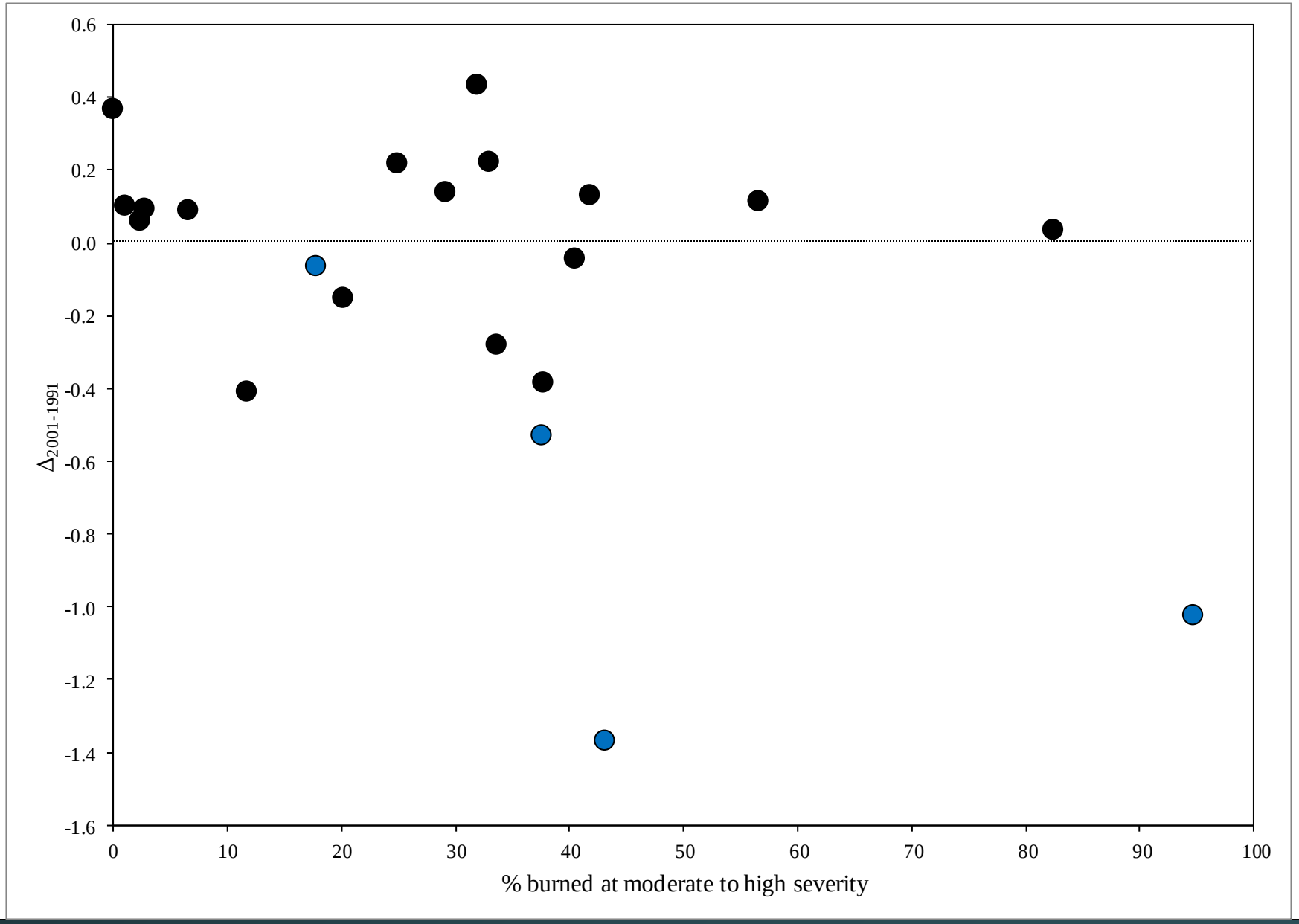
Indirect effects: persistent warming



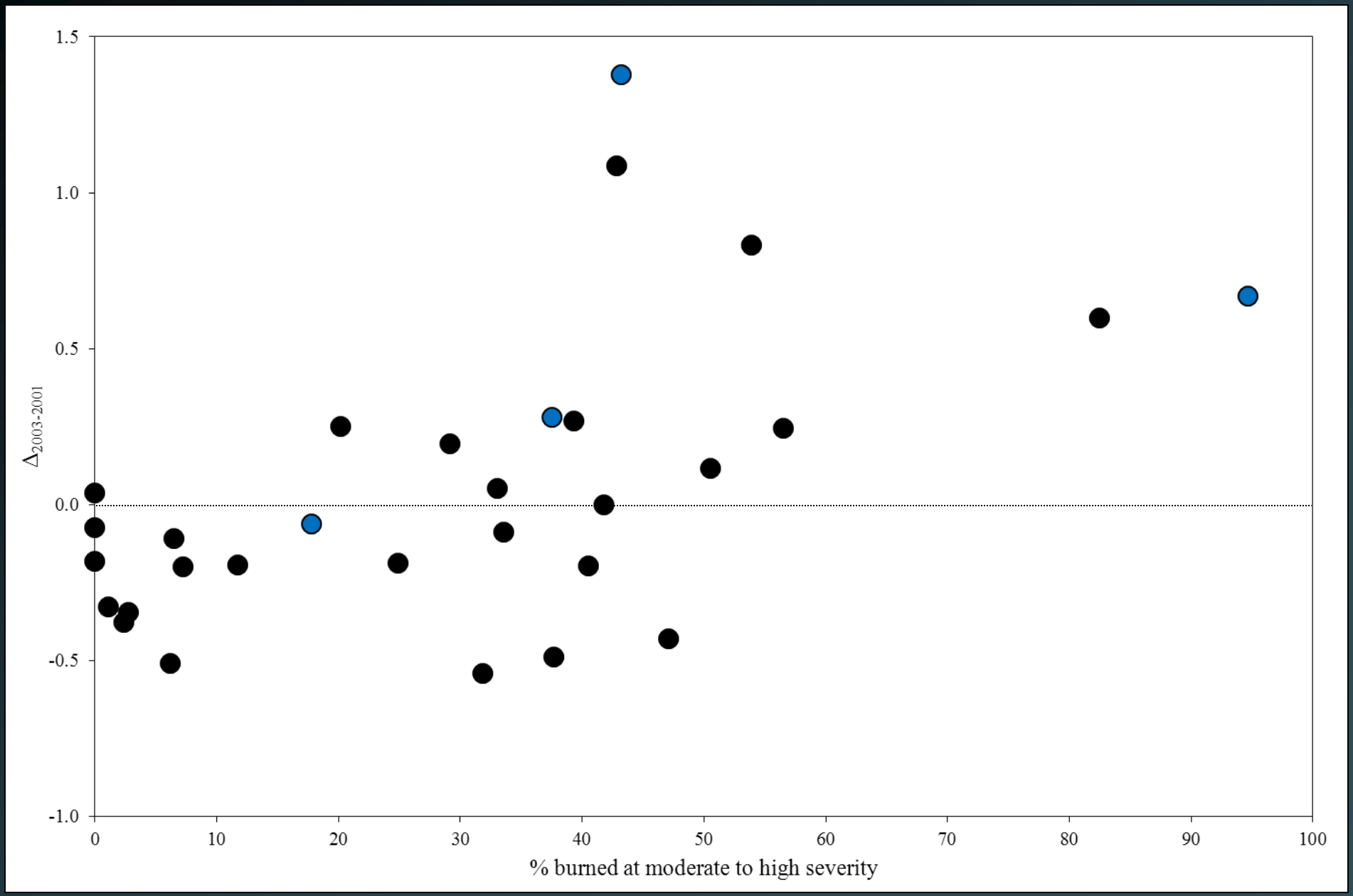
Habitat structure: no short-term trend

Fish assemblages

Pre-fire/post-fire change: cutthroat trout



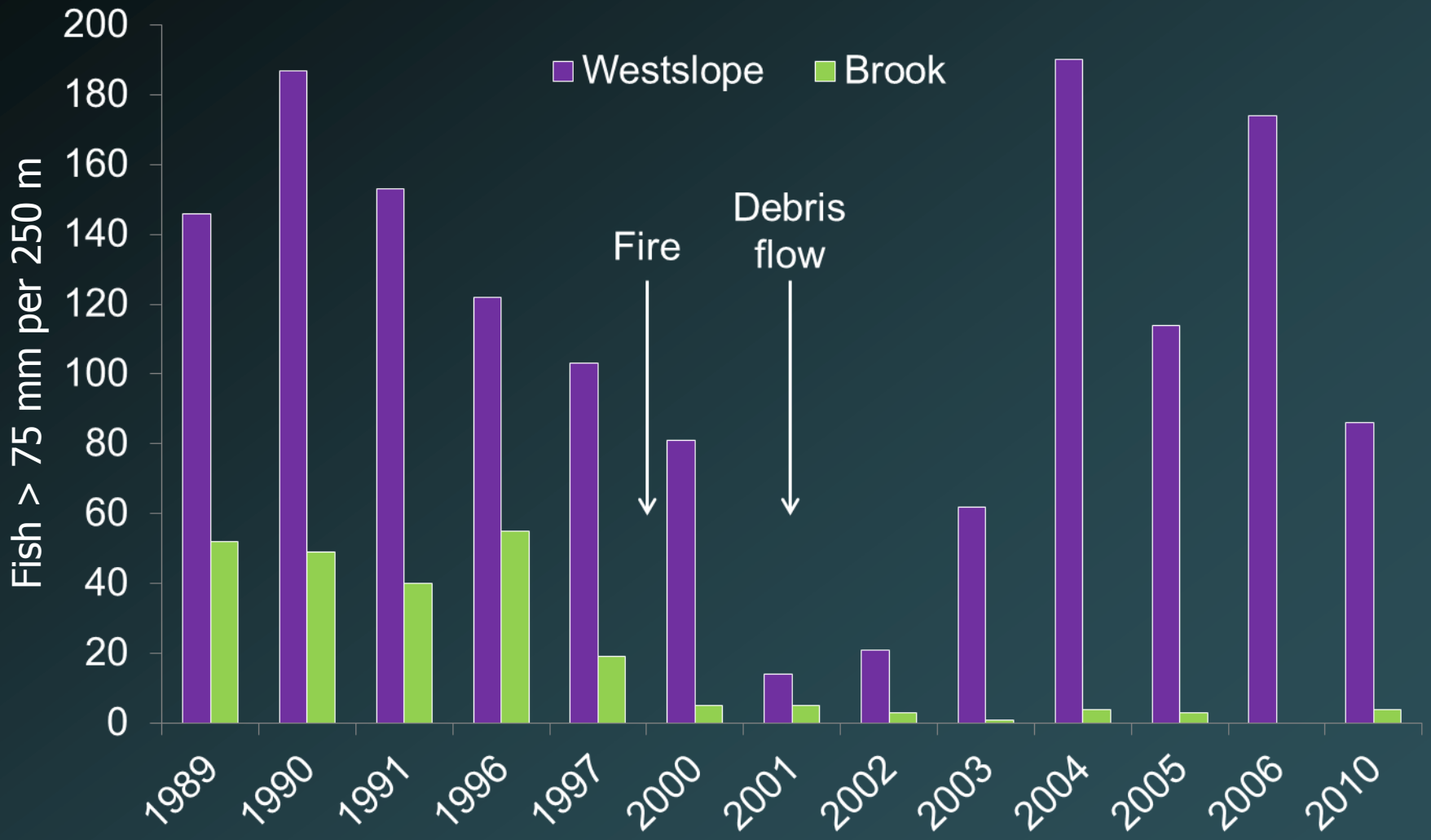
Short-term post-fire change: cutthroat trout



Mid-term post-fire patterns: 10+ years

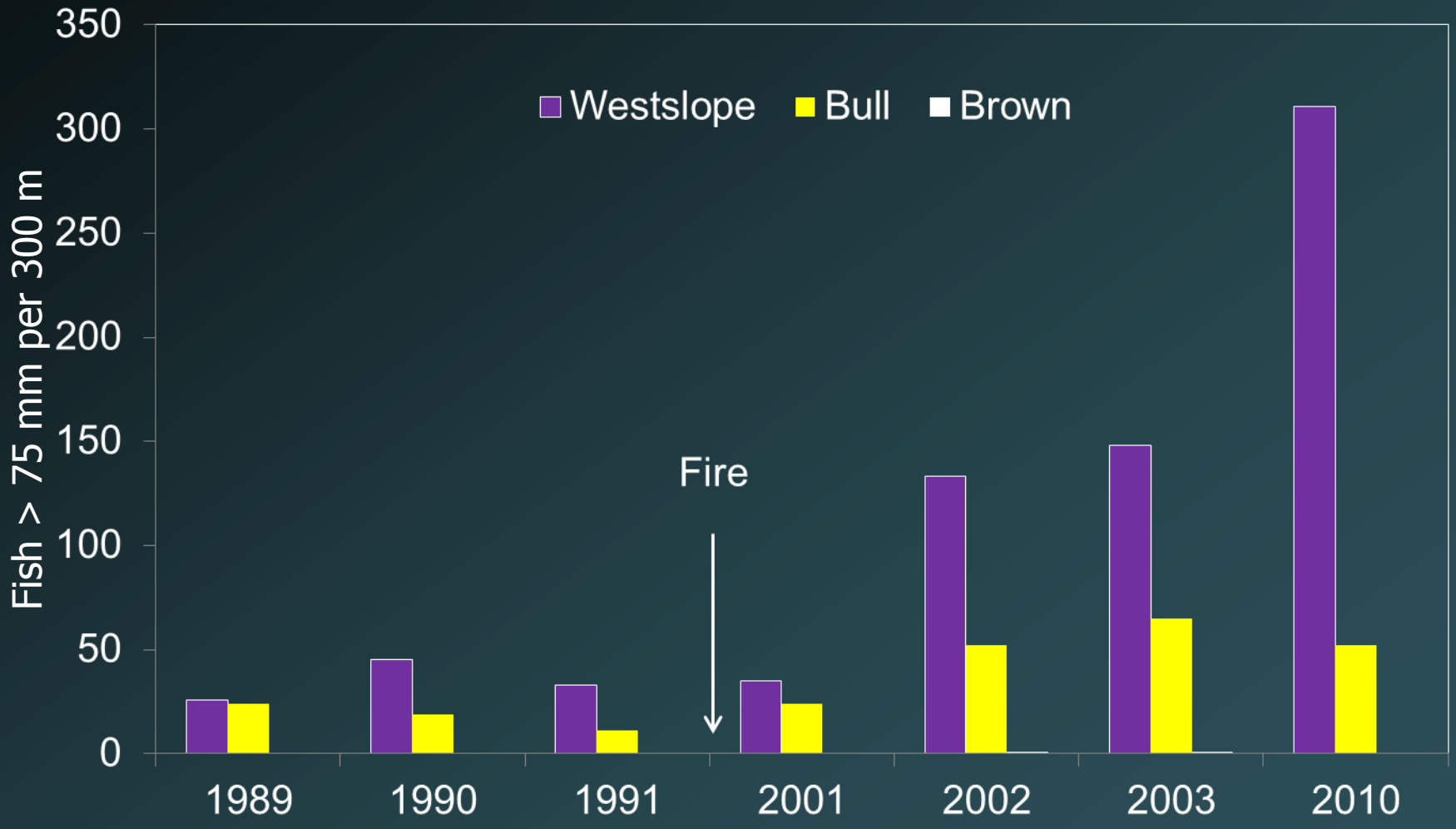
Reaches with debris torrents

North Rye Creek



Reaches without debris torrents

Meadow Creek



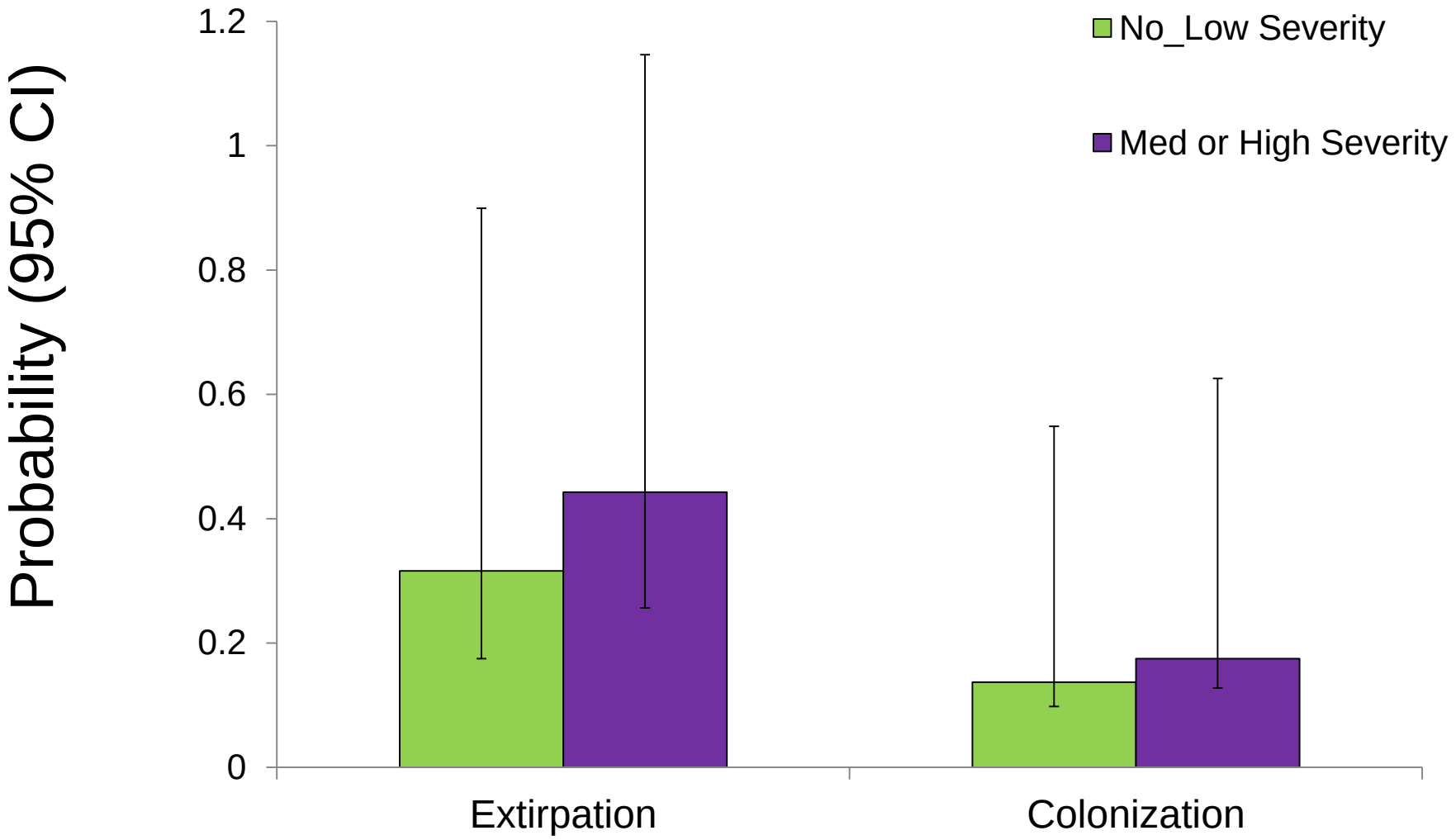
Bull trout occupancy

Bull trout are thermally sensitive and declining
- Higher losses in warmer, lower elevation sites
- Higher losses in areas that burned

Is extirpation greater than recolonization?
- P(extirpation) = 0.37 (0.09) > P(colonization) = 0.11 (0.07)

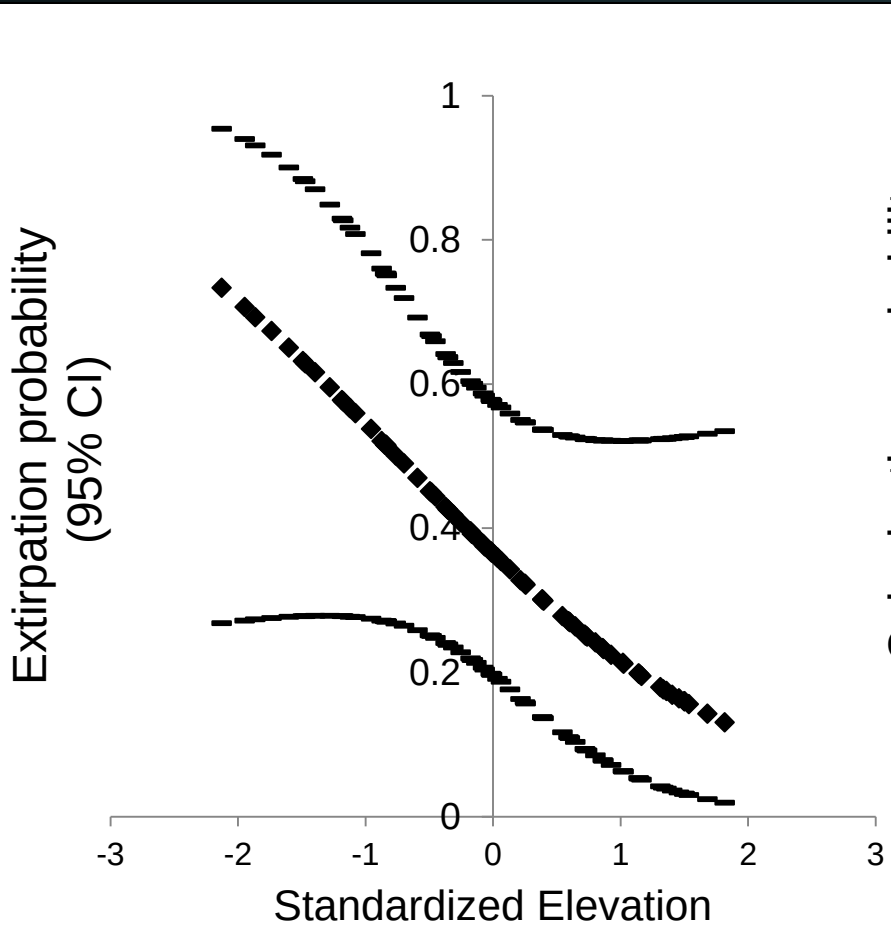
Is fire an informative covariate?

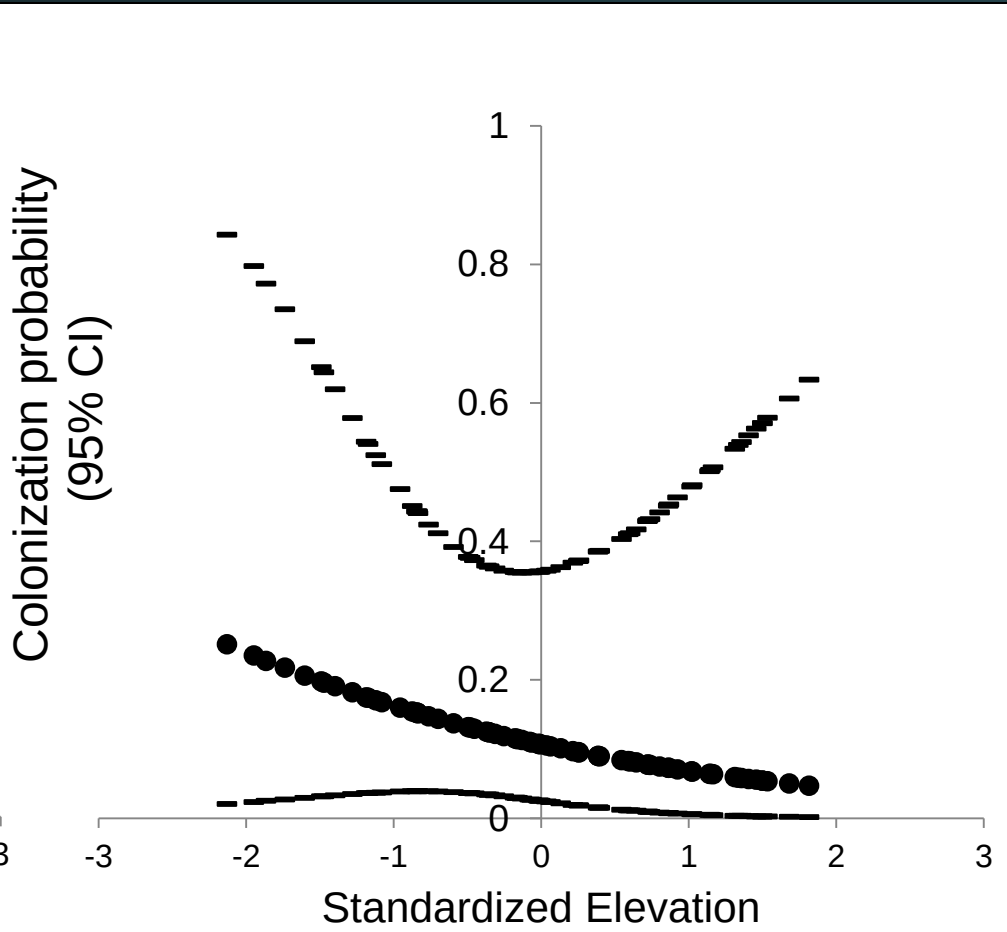
Bull trout occupancy



Bull trout occupancy

- Losses exceed gains in warmer, lower elevation sites
- NS effect of fire





Conclusions

- Low-severity fire had little effect on habitat or fish.
- In severely burned reaches, temperatures increased and remain elevated.
- Native fish declined in severely burned reaches, primarily in association with debris torrents.
- In contrast, post-fire abundance in native fishes was positively related to burn severity (regardless of debris torrents).
- Cutthroat trout increases appear “durable.”
- Fires are a mixed bag for bull trout.
- Nonnative species responded variably.
  - Brook trout usually declined and often did not recover.
  - Brown trout frequently invaded post-fire.

Literature

Dunham, J. B.,M.K.Young, R. E. Gresswell, and B. E. Rieman. 2003. Effects of fire on fish populations: landscape perspectives on persistence of native fishes and non-native fish invasions. Forest Ecology andManagement 178:183–196.

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Sestrich, C. M., T. E. McMahon, and M. K. Young. 2011. Influence of fire on native and nonnative salmonid populations and habitat in a western Montana basin. Transactions of the American Fisheries Society 140: 136-146.

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